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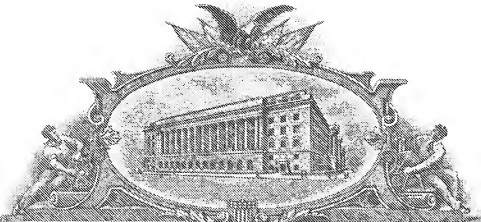

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APPLICATION NUMBER: ***60/556,577***
FILING DATE: ***March 26, 2004***
RELATED PCT APPLICATION NUMBER: ***PCT/US05/10302***

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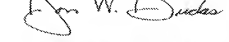

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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

INVENTOR(S)

Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
Jesus Luis	Gonzalez Sordo	Madrid, Spain Madrid, Spain

☐ *Additional inventors are being named on the ___ separately numbered sheets attached hereto*

TITLE OF THE INVENTION (280 characters max)

HYDRAULIC AUXILIARY HOIST AND CRANE CONTROL FOR HIGH PRECISION LOAD POSITIONING

Direct all correspondence to: **CORRESPONDENCE ADDRESS**

☑ Customer Number 26710

OR *Type Customer Number here*

☐ Firm or Individual Name					
Address					
Address					
City		State		ZIP	
Country		Telephone		Fax	

ENCLOSED APPLICATION PARTS *(check all that apply)*

☑ Specification *Number of Pages* 11 including photos 1-10 ☐ CD(s), Number

☑ Drawing(s) *Number of Sheets* 3 ☑ Other (specify) Return Postcard

☐ Application Data Sheet. See 37 CFR 1.76

METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT

☐ Applicant claims small entity status. See 37 CFR 1.27.

☐ A check or money order is enclosed to cover the filing fees

☑ The Commissioner is hereby authorized to charge filing fees or credit any overpayment to Deposit Account Number: 17-0055

☐ Payment by credit card. Form PTO-2038 is attached.

FILING FEE AMOUNT ($) $160.00

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☑ No.

☐ Yes, the name of the U.S. Government agency and the Government contract number are: _____

Respectfully submitted,

SIGNATURE _____

TYPED or PRINTED NAME John D. Franzini

TELEPHONE (414) 277-5747

Date 03/ 26 / 04

REGISTRATION NO. *(if appropriate)* 31,356

Docket Number: 130324.00069

USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

This collection of information is required by 37 CFR 1.51. The information is used by the public to file (and by the PTO to process) a provisional application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 8 hours to complete, including gathering, preparing, and submitting the complete provisional application to the PTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, Washington, D.C. 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Box Provisional Application, Assistant Commissioner for Patents, Washington, D.C. 20231.

Hydraulic Auxiliary Hoist and Crane Control for High Precision Load Positioning

Digital Hydraulics Turn Lifting into High Accuracy Hoisting and Positioning System

Since the advent of hydraulic jacks or lifting cylinders, construction engineers have had the capability to raise and relocate structures, bridges or buildings of almost any size and tonnage – even entire city centres to allow new underground installations such as subways or essential repair work.

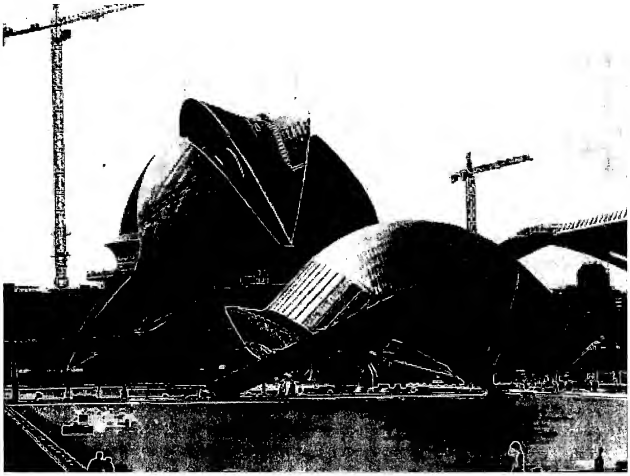


Photo 1:
The architectural designs of Santiago Calatrava often require creative technological solutions. Enerpac SyncHoist System is one of them and used for roof positioning of the Palace of the Arts in Valencia (Spain).

In theory there are no limits..... the greater the weight, the more cylinders are employed. But the extent of a straight lift has always been limited to the plunger stroke length of the cylinders used. To lift beyond that limit stage lifting has involved additional holding arrangements to permit the replacement or repositioning of cylinders for the next stage in the lifting operation.

Product value statement

With the use of single cranes, heavy loads, such as large construction segments (roof sections, floor sections, wall sections, large scale architectural ornamentation, bridge sections, etc.), can move long vertical distances with relative high speed. For the geometric positioning of heavy loads in a vertical and horizontal plane, it happens that multiple cranes are used in the lifting industry. Synchronizing movements in this fashion has proved to be difficult and risky. Also from a lifting accuracy standpoint this application has often resulted in damaging the load and/or support fixtures or cranes and even putting the workers at risk. In addition, sudden crane starts and stops create oscillations during the critical stages of the lifting process. Weather conditions also play an active role when using multiple cranes during heavy load positioning applications, as wind can blow a lifted section so as to place dangerous side loads on the crane, that the crane was not designed to endure.

This is where the value of the Enerpac SyncHoist system comes in. The Enerpac SyncHoist system is a hydraulically operated auxiliary attachment for high precision load positioning with cranes. With the use of a single crane, the load can now be precisely maneuvered in a vertical and horizontal plane, while reducing risk and cost and vastly improving operating speed and worker safety. Also, when using the Enerpac SyncHoist system, weather conditions play a less critical role in comparison to applying multiple cranes, as the load can be reoriented to compensate for and minimize the effects of wind on it.

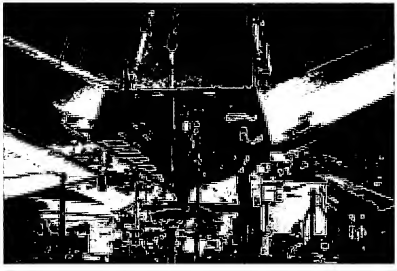


Photo 2:
Palace of the Arts in Valencia (Spain): Relocation works with Enerpac SyncHoist System.

A perfect marriage

Today, however, the invention brings numerous possibilities to move, position and control heavy loads and large objects. Lifting power is provided by the crane while the integrated Enerpac intelligent SyncHoist System provides a smooth and high accuracy counterweighing and positioning of heavy loads and structures. Accurate positioning can be managed in the top of the crane by the crane operator or by the construction workers on the roof with the use of remote control units.

High Accuracy Hoisting – Integrated Hydraulic Solution

Hoisting, moving and positioning with high accuracy can now be done using only one crane with Enerpac integrated hydraulics. In many construction hoisting applications, the hydraulic control of load movement makes the demand for more than one crane redundant. This integrated hydraulic solution turns hoisting into a more efficient and cost effective means of handling, and ensures better control of vertical transportation and load positioning, reducing the costs of hiring additional cranes, assembling time and requiring less space on the construction site. In conventional hoisting one crane is used for each lifting point. Now, with the Enerpac SyncHoist System one crane can handle multiple lifting points with an accuracy of ± 1 mm.

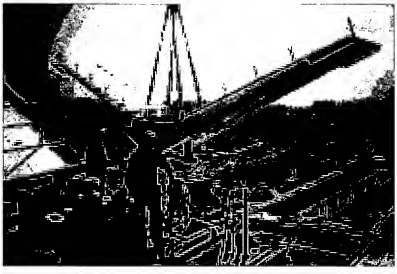


Photo 3:
Palace of the Arts: Segments are hoisted from the ground, being relocated with four cylinders fully monitored.

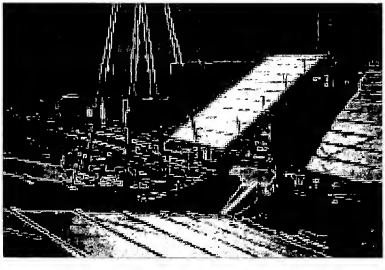


Photo 4:
Palace of the Arts: The SyncHoist positioning system with pull cylinders relocating the roof segments prior to welding.

Hydraulic System Integration

Between the cables of the crane, hydraulic cylinders are included and precisely electronically controlled in their extension. Each lifting point has it's own cable and cylinder. These cylinders are double-acting pulling cylinders. The double-acting function allows precise control of both lifting and lowering adjustments in each cable. The maximum hydraulic pressure is 700 bar while the cylinder pulling capacity depends on the type of application. However, the maximum load is only limited by the lifting capacity of the cable, not by the hydraulic system. The hydraulic system features management of digital and electronic signals. The cylinders are equipped with electrical stroke sensors measuring the exact plunger travel. In this way every movement of all lifting points can be checked at the same time. Plunger strokes of 1500 mm are not uncommon in hoisting and positioning applications with 4 or 6 lifting points. The maximum positioning accuracy with Enerpac SyncHoist is +/- 1 mm, but the elasticity of the cables must be considered.

Hydraulic system management can be done by digital electrical signals. The type of remote control unit depends on the system function. For counterweighing and pre-programmed movements, a PLC (programmable logic controller) control unit is preferred.

IMPORTANT ADVANTAGES:

- Cost reduction from using a single crane vs. multiple cranes
- High accuracy (+/- 1,0 mm)
- Reduces or eliminates risk of damage
- Improved productivity
- Safer working environment

EASE OF USE:

- Once the load is moved within a short distance of its final position (using a single crane), the Enerpac SyncHoist system positions the load with high accuracy.
- No need to use crane jogging i.e. sudden starts & stops of the crane, causing oscillations of the wire rope and premature wear of crane brakes.
- Operating simplicity such as wireless remote control and read outs.

The Enerpac SyncHoist System can be used for a wide variety of functions such as high accuracy relocating, pre-programmed relocating, pre-programmed twisting or turning and counterweighing (determining centre of gravity).

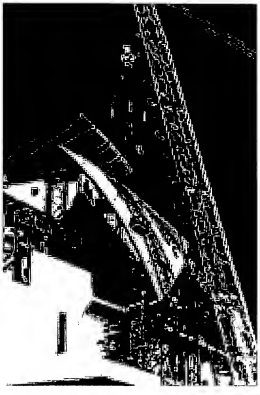


Photo 4:
Roof positioning of Palace of the Arts: All roof segments are welded on the ground, hoisted and positioned using a 4 points SyncHoist Enerpac hydraulic relocating system.

TYPICAL APPLICATIONS:

- Positioning of roof sections, concrete elements, steel structures etc. in the construction industry.
- Precise positioning of turbines, transformers, fuel rods etc. in the utility industry.
- Precise machinery loading, mill roll changes, bearing changes etc. in the heavy equipment industry.
- Precise positioning of pipe lines, blow out valves etc. in the petrochemical and oil & gas industry
- Relocating and positioning of ship segments in shipbuilding industry.

A unique position

Enerpac has proven to be the reliable partner for controlled hydraulic movement and weighing, moving and high accuracy positioning of high tonnage loads and large structures. Enerpac SyncHoist systems with

integrated PLC-controls are beyond today's standards as it comes to overcome critical requirements as precise counterweighing and relocating structures to their final position and ascertain not only safe but also cost effective handling and transportation.

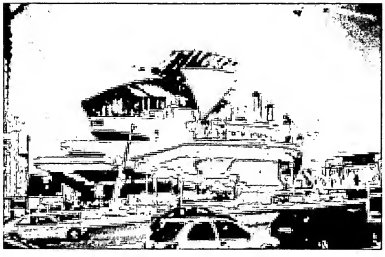


Photo 6:
Counterweighing and relocating the main roof of the Palace of the Arts. After positioning, the segments are supported by an 8 points Enerpac synchronous lifting system.

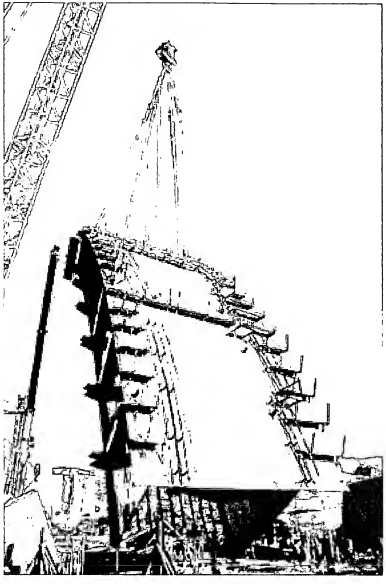


Photo 7:
Roof lifting of the Auditorium at Tenerife at the Canary Island – Spain. A 4-points SyncHoist Enerpac hydraulic relocating system is used for accurate roof positioning. Each double-acting cylinder with a pull capacity of 59 ton at 700 bar pressure has a stroke of 1500 mm.

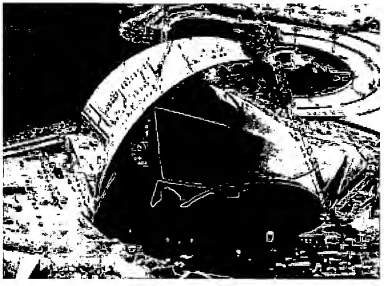


Photo 8:
Between the cables in the boom of the crane four Enerpac cylinders are used for determining the centre of gravity and relocating the steel roof segments of the Auditorium at Tenerife.

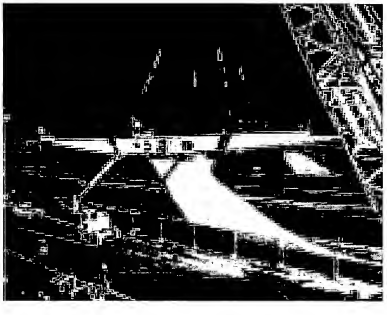


Photo 9:
Bridge segments are positioned using an Enerpac four points high accuracy hoisting system.

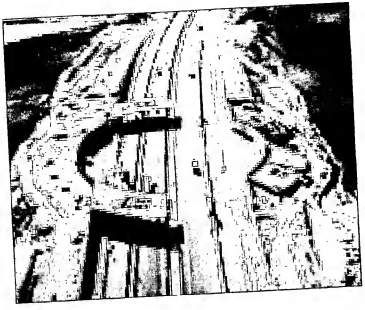


Photo 10:
During bridge construction Enerpac four points High Accuracy Hoisting System is used to relocate and position the segments of the Vallecas Donut Bridge in Madrid.

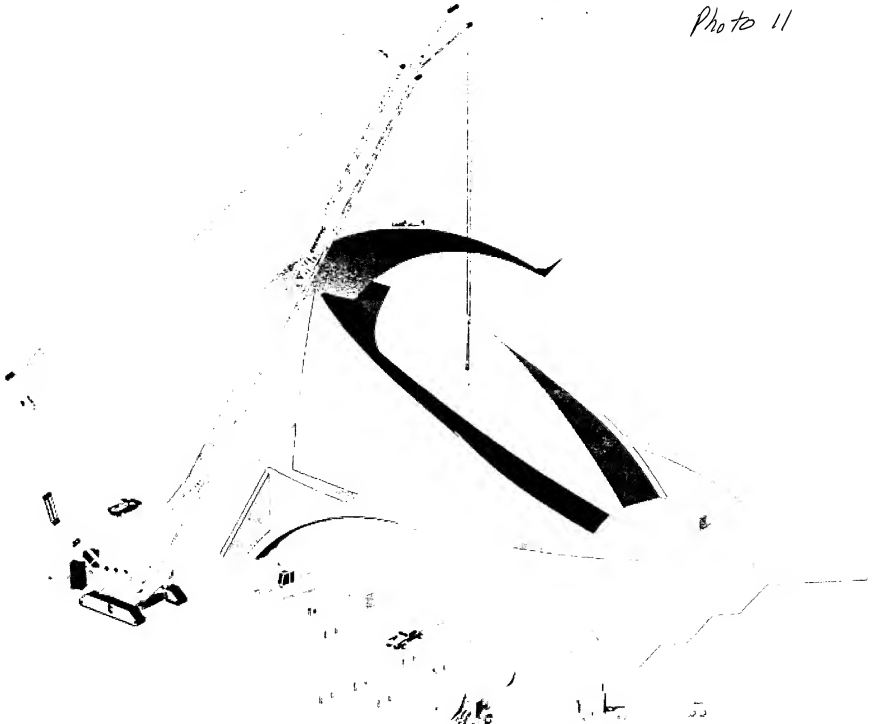
Photo 11, attached, illustrates a single crane lifting a roof section of a complex shape, equipped with a system of the invention.

Photo 12 illustrates a V-shape load being prepared to be lifted using a four point system of the invention, with four cables suspended from the main crane lifting hook, and a double acting cylinder at the lower end of each of the four cables, and means at the lower ends of the cylinders to connect to four spaced apart points, for example the corners of a rectangle, on the upper surface of the load. Such an arrangement is shown in Photo 13. The cylinders are hydraulically powered, and operated by electrical valves that are controlled by a computer controller. An operator can input to the controller the shape, weight or material, and other information that describes the load and the position of the attachment points on the load. Formulas or look-up tables can also be input to the computer so that the operator can input a specific movement to the controller, for example move the northwest corner of the load down a certain distance, or do that while holding the position of the southeast corner constant, or a more complex movement, possibly involving the movement of all four corners (or other reference points) of the load at the same time. The controller can then calculate how much each of the four cylinders must be extended or retracted to effect the requested movement, and operate the valves so as to do so. While doing so, the controller can constantly monitor the position sensor of each cylinder (which may be of an LVDT or other well known type) so as to retain feedback control over the positioning operation.

The pressure in each cylinder, or preferably the force exerted on each cylinder, can also be monitored by the controller and this information used as an input. This can be done by installing a load sensing cell in series with each cylinder, to sense the load on each cylinder. Inputs from such sensors can be used by the controller to balance the load, or to instantaneously, or nearly instantaneously, correct for weather related abnormalities, like if a wind blows a load sideways, the controller can extend or retract the cylinders to present the smallest possible area for the wind to blow against, to balance the load, or to adust the cylinders to retain the orientation of the load relative to the structure in which the load is being installed. The loading capacity limits of the crane can also be programmed into the controller so that the controller can make preventative adjustments to the cylinders if the capacity limits of the crane are approached.

A sensor could also be added to provide one or more inputs to the controller that would indicate the angle of the main suspension line of the crane relative to the crane, so that could be maintained by the controller adjusting the cylinders. A hydraulic rotary coupling could also be added into the main line and adjusted by the controller operating an electrical valve to control the angle of the rotary coupling, with an angle sensor input to the controller, so the controller could control the angle of the load about a vertical axis.

Photo 11



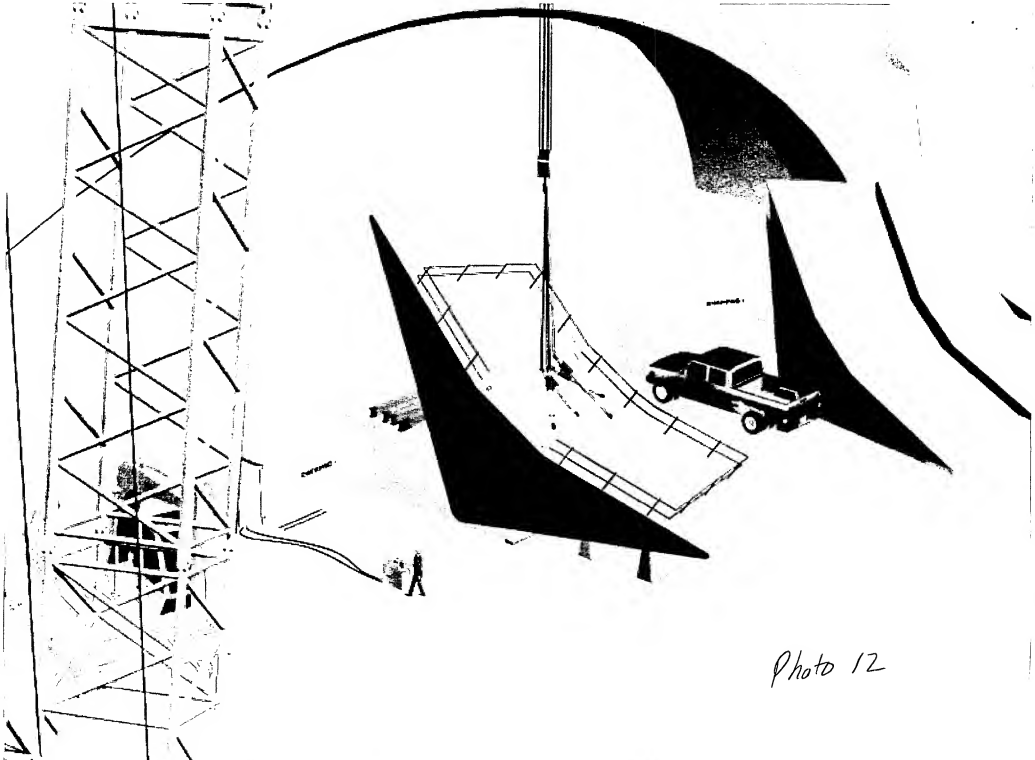


Photo 12

Photo 13